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Maritime Domain Awareness:
The Key to Maritime Security
Operational Challenges and Technical Solutions

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“Global Maritime Domain Awareness is the first step to an effective end game. Global MDA will allow us to detect, surveill, identify, classify, and interdict vessels of interest. Global MDA gives us the cued intel that will provide the situational awareness and clarity necessary to determine if a vessel is friend or foe.”

Admiral Thomas Collins
Commandant, U.S. Coast Guard
National Defense University
December 1, 2004



“Our goal is to gain increased information sharing and enhanced situational awareness in order to facilitate international cooperation to improve security and cue effective threat responses. Development and fielding of Maritime Domain Awareness tools and applications will be central to this effort.”

Admiral Walter Doran
Commander, U.S. Pacific Fleet
Remarks at “West 2005”
February 2, 2005



A Process to Instantiate Maritime Domain Awareness



- The nature of the Maritime Domain Awareness challenge
- Maritime Domain Awareness: laws, policies, and operational concepts
- Functional and technical approaches to instantiating MDA for the total ship force



Maritime Domain Awareness: The Nature of the Challenge



“It seems to me that it is in the maritime domain that we have the greatest potential to substantially improve our homeland defense.”

Paul McHale

ASD for Homeland Defense

December 21, 2004



The Nature of the Challenge

A Vast and Increasingly Crowded Space



- Oceans encompass over 140 million square miles
- Maritime trade has increased 220% since 1975
- Over 100,000 ocean-going ships
- Over 10,000,000 fishing vessels and pleasure craft
- Six billion tons of trade carried by sea in 2001
- Bulk of trade—46,000 vessels servicing 4,000 ports
- Oil demand - 77 to 120 million barrels by 2025



The Nature of the Challenge Oceans as a Medium for Unlawful Activity



- Terrorism
- Piracy
- Transnational crime
- Illegal immigration
- Drug and Contraband Smuggling
- Transportation of WMD



The Nature of the Challenge Oceans as a Medium for Unlawful Activity



- Terrorism
- **Piracy**
- Transnational crime
- Illegal immigration
- Drug and Contraband Smuggling
- Transportation of WMD

The Nature of the Challenge: Piracy Increasing – Often Dramatically

- International Maritime Bureau: Somali coast one of the most dangerous stretches of water
- Pirates want more than goods on board ship
- January 2005 - March 2006: 45 attempted hijackings and 19 successful ones occurred off Somali coast
- US Navy (CTF 150) now engaged in combating piracy in region





The Nature of the Challenge Sorting Suspect Vessels From the Rest



- Specific needs differ in community of nations
- All have shared requirement for enhanced MDA
- Pooling resources and sharing a COP are key
- Challenges involve aligning policy & operations



Maritime Domain Awareness: Laws, Policies and Operational Concepts



“The security of the maritime domain is a global issue. The United States, in cooperation with our allies and friends around the world...will work to ensure that lawful private and public activities in the maritime domain are protected against attack and criminal and otherwise unlawful or hostile exploitation.”

Fact Sheet

Maritime Security Policy

National Security/Homeland Security

January 13, 2005



Relevant Domestic and International Laws and Policies :

- International Environment: Law and Policies
 - Formulating International Policy Challenging but *Not Impossible*
- U.S. Domestic Environment: Law and Policies
 - Maritime Security: Key Issue for the United States
 - *National Strategy for Maritime Security*
 - *National Plan to Achieve Maritime Domain Awareness*

International Laws and Policies

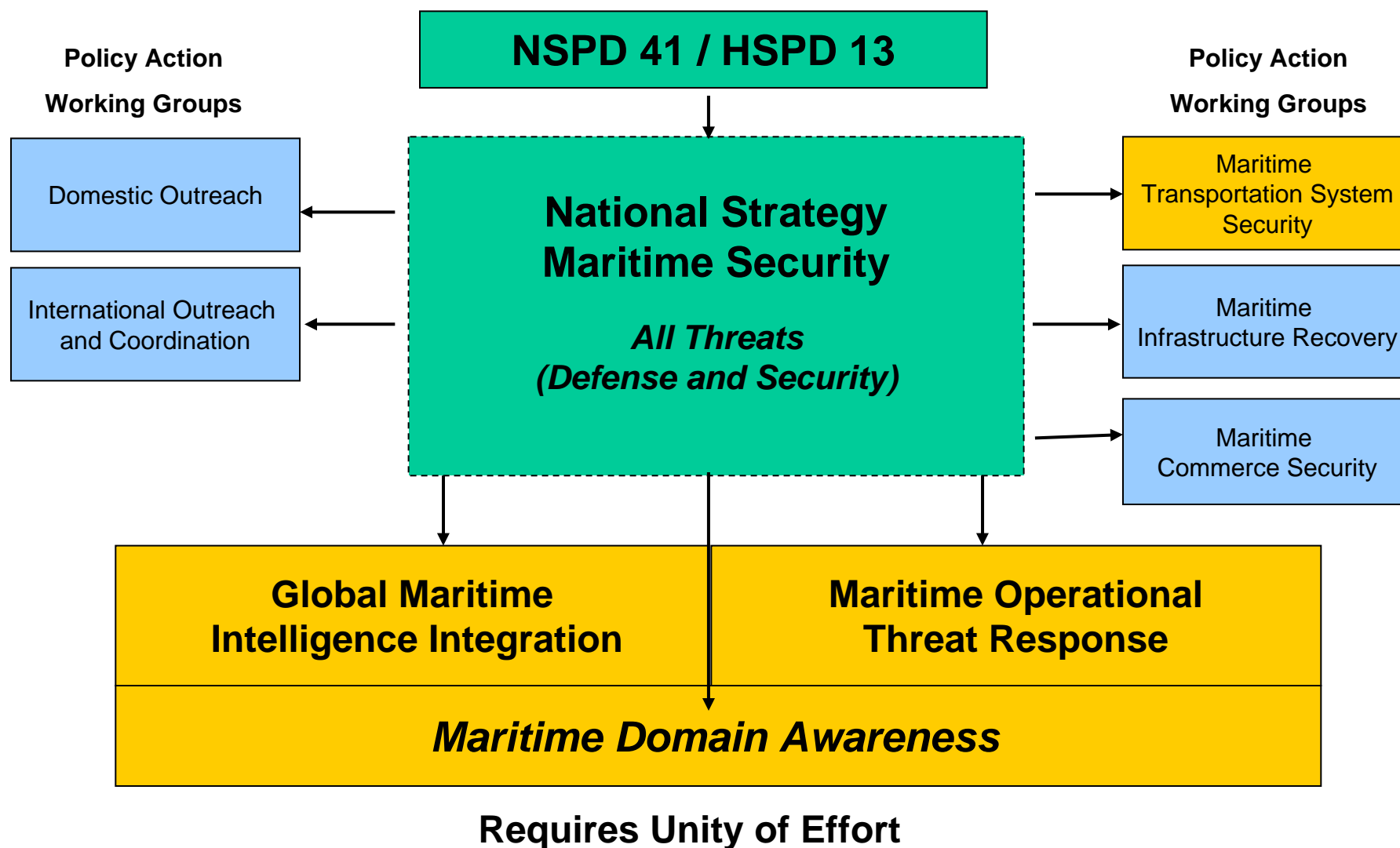
- 1974 International Convention for the Safety of Life at Sea (SOLAS)
- 1982 United Nations Convention on the Law of the Sea (UNCLOS)
 - Established a set of rules/rights while traversing through various zones of the oceans
- United Nations Security Council Resolution
 - Resolution of September 28, 2001
 - Comprehensive measures - combat international terrorism
- International Maritime Organization (IMO)
 - Provides guidelines to gain jurisdiction to intercept pirates at sea
 - Report of May 20, 2002 – *Oceans and the Law of the Sea*
 - Comprehensive report addressing crimes at sea
 - Focuses on attacks on ships in the territorial sea



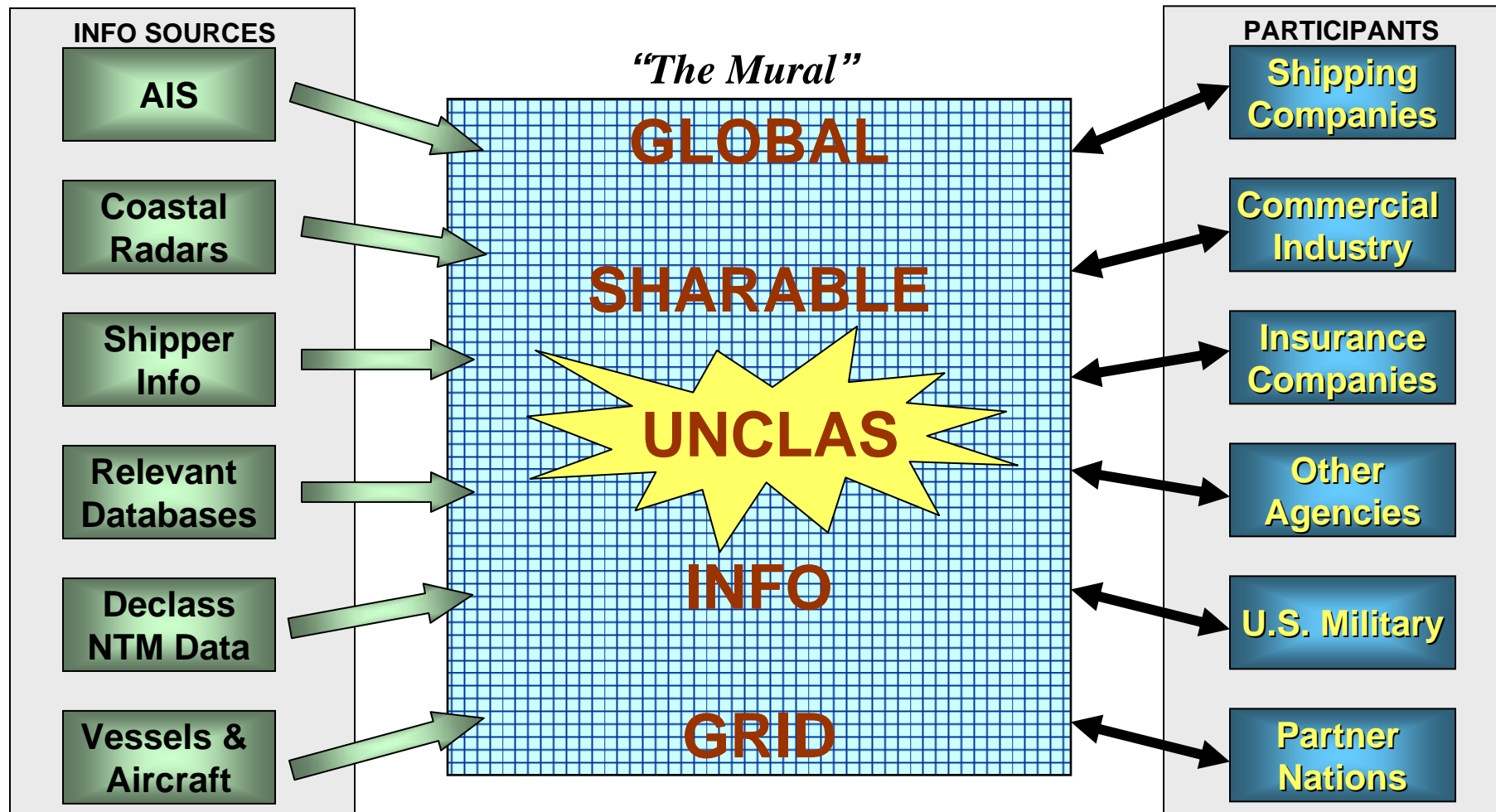
Domestic Laws and Policies



- Maritime Security: Key Issue for the United States
 - *The National Strategy for Maritime Security*
 - *National Plan to Achieve Maritime Domain Awareness*
 - DoD Top Priority: Global War on Terrorism Encompasses Securing the Maritime
 - DoN Focus: GWOT and Partner in Achieving MDA
 - DHS/USCG Focus: GWOT and Partner in Achieving MDA
- Examples of Current Initiatives In Place
 - Maritime Transportation Security Act 2002
 - Proliferation Security Initiative
 - Container Security Initiative
 - Automatic Identification System



Maritime Domain Awareness: Concept of Operations



- Facilitates Spotlighting of Anomalies and COIs
- Operationalizes 1000-Ship Navy

- Builds Trust, Confidence and Cooperation
- Builds Partner Capacity



Maritime Domain Awareness: Functional & Technical Approaches to Solving the Operational Challenge

“The heart of the Maritime Domain Awareness program is accurate information, intelligence, surveillance and reconnaissance of all vessels, cargo and people extending well beyond traditional maritime boundaries.”

President George W. Bush
*Securing the Homeland,
Strengthening the Nation*
January 20, 2002



Technical Approaches to Solving Operational Challenge



- **Functional Component**
 - “What is it we need to do to achieve MDA?”
- **Technical Capabilities**
 - “What tools do we need to achieve MDA?”



A Functional Approach to Instantiating Maritime Domain Awareness Across the Integrated Ship Force



Functional Component



“What is it we need to do to achieve MDA?”

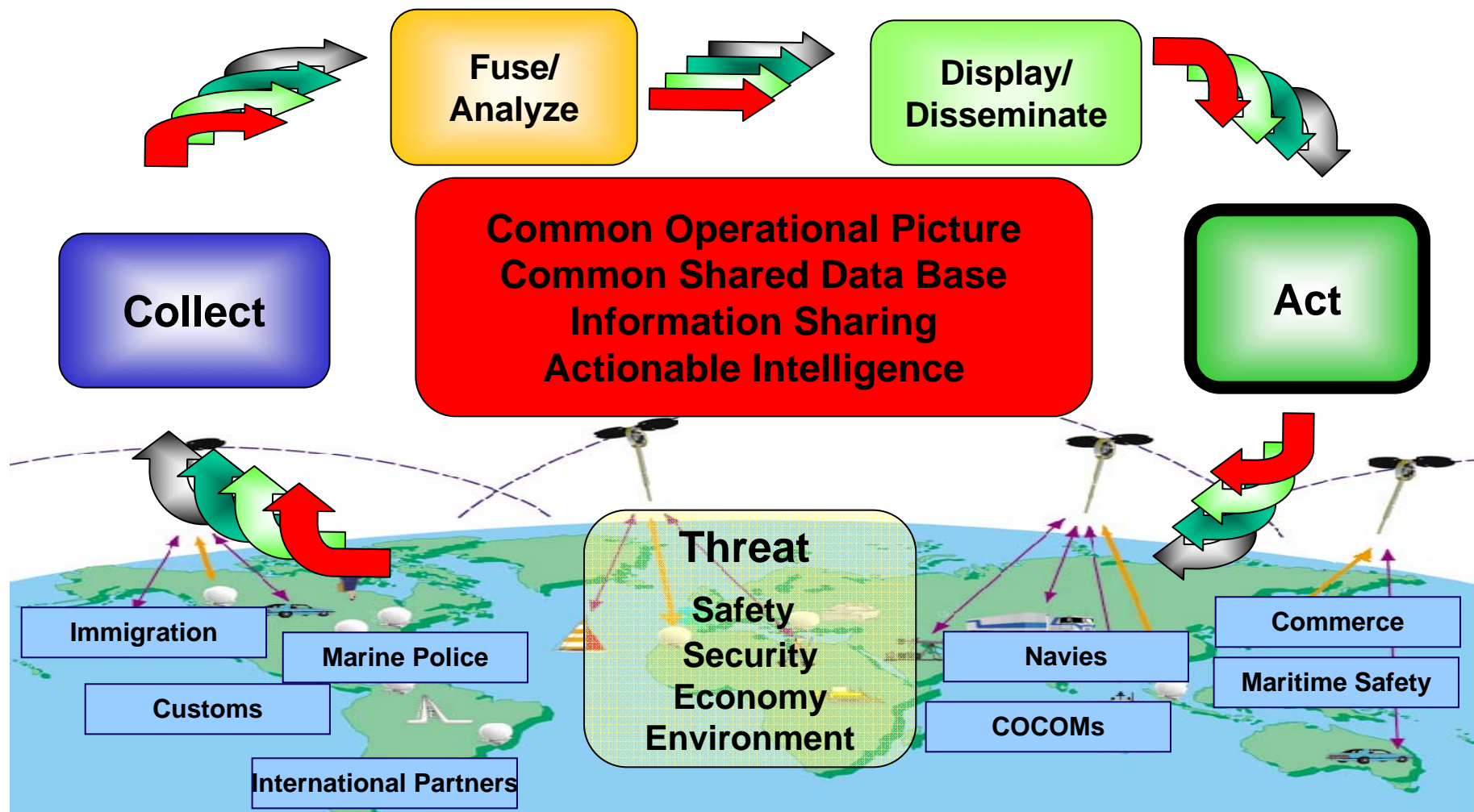
- Core competencies
- Repeated iteratively
- Bound the challenging technical trade space
- Provide vehicle for international cooperation



The Operator's or Practitioner's Perspective...

Functional Capabilities

The Operational MDA Concept

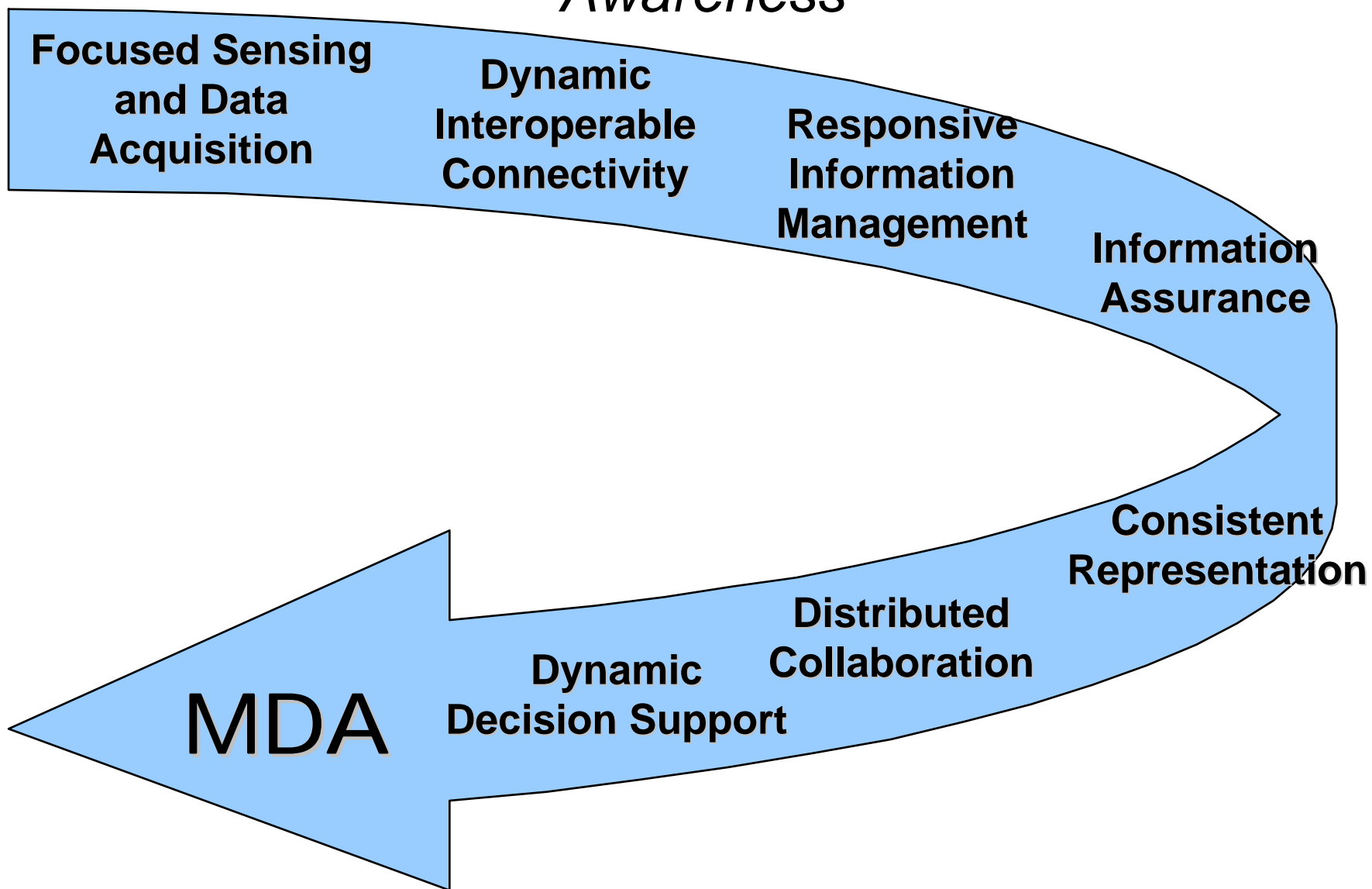




...Translated to the Technical
Perspective

Functional Capabilities

Core Competencies for Maritime Domain Awareness





A Technical Approach to Instantiating Maritime Domain Awareness Across the Integrated Ship Force

Technical Capabilities

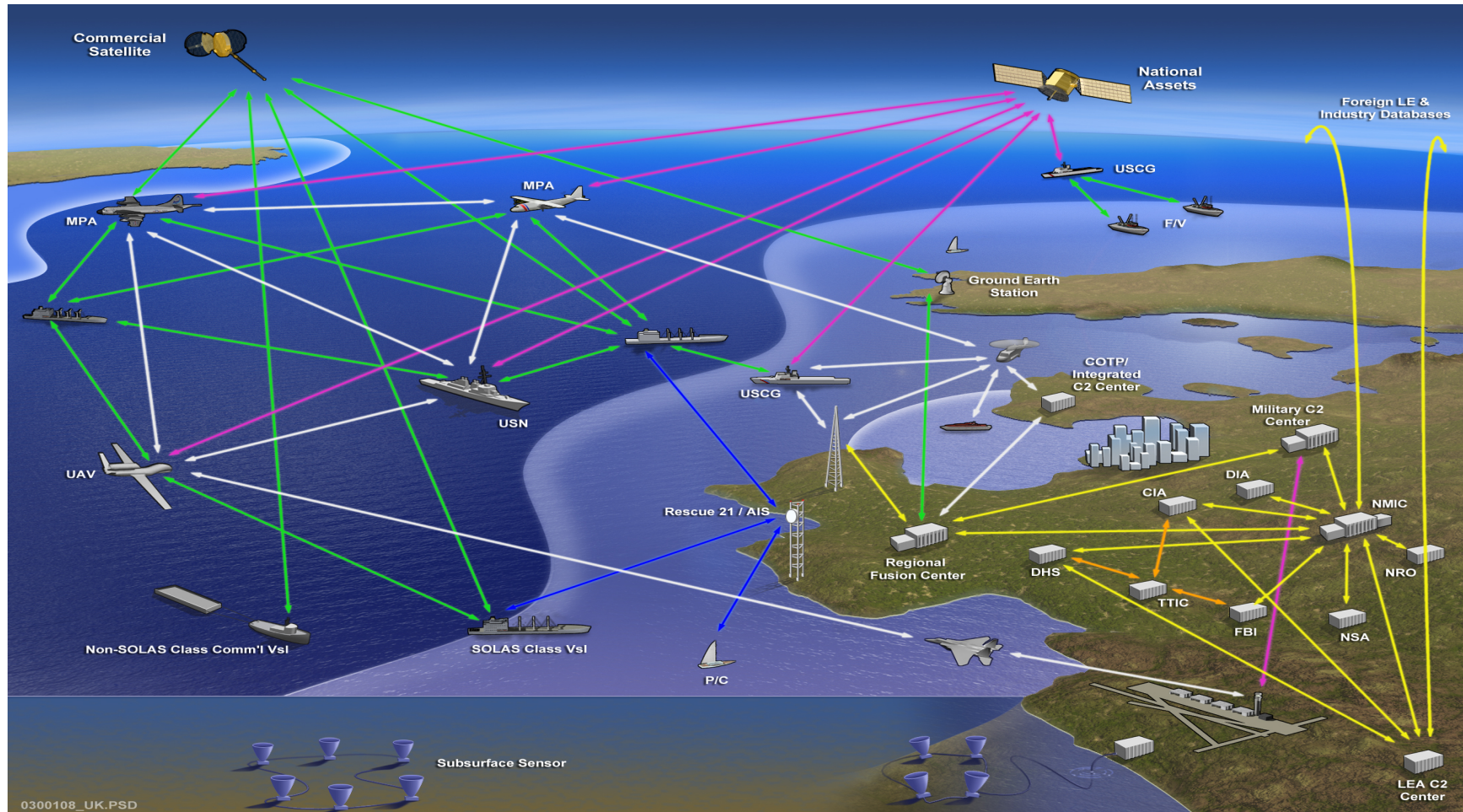
“What tools do we need to achieve MDA?”

- Seven core competencies all important
- Some present greater challenges than others
- Focus on the “bookends” – FSDA & DDS – while not ignoring the others
- If we get those two right – we are close to a solution



Technical Capabilities: Focused Sensing and Data Acquisition

Technical Capabilities: Focused Sensing and Data Acquisition





Technical Capabilities Focused Sensing and Data Acquisition



- Track all vessels all the time
- Understand what the tracks are telling us
- Adapt to normal and expected changes
- Use AIS and models to detect anomalies
- Universe of available sensors is quite large
- Automated sensor fusion a key requirement



Focused Sensing & Data Acquisition Technology Sorting by Zones

- High Seas
- Exclusive Economic Zone
- Territorial Sea and Contiguous Zone
- Ports, Bays, and Inland Waterways

SSC Sensor Activity in Different Zones

SAN DIEGO

Overview



Sensor CONOPS follows common paradigm to detect and identify all vessels, resolve anomalies, then take action

Detect

- Wide area surveillance
- Detect vessels by zone, cooperative, emitting and dark

Identify

- Vessel classification and identification to “declutter” the picture
- Declared identification (AIS) or vessel fingerprints (SEI)

Assess Risk

- Vessel history and particulars (ownership, cargo)
- Try to resolve vessels with unknown identification
- Follow-up tasking to ID, collect details, other data

Track

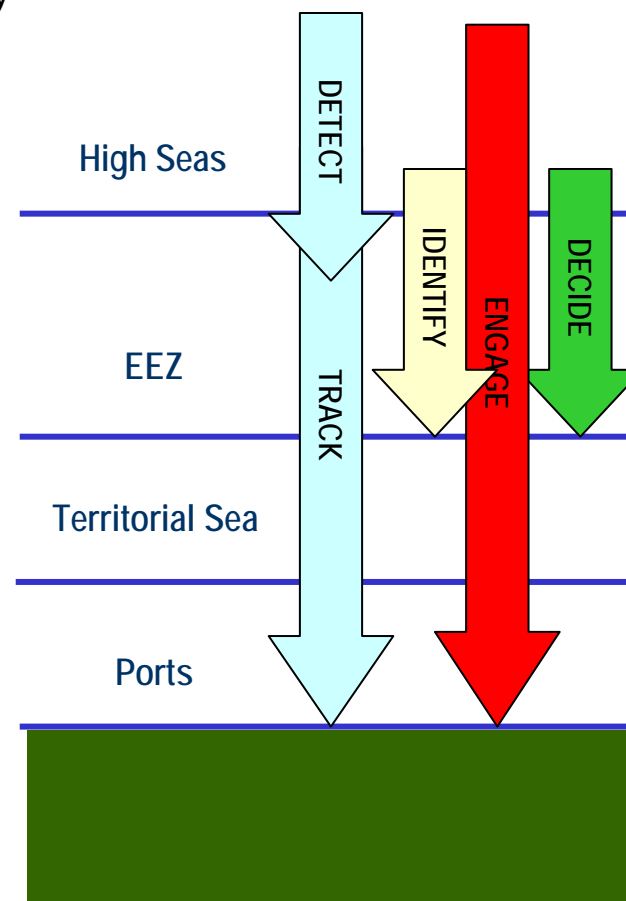
- Maintain a track throughout passage in area of interest
- Correlate and integrate with COP

Detect Anomalies

- Alert to threat-like or unusual behavior

Intercept

- Remaining high risk or suspect vessels intercepted
- Boarded, inspected, detained as required





Technologies That Support MDA on the High Seas

Technologies That Support MDA on the High Seas

- Existing Capabilities
 - Satellites and Global Position Tracking devices
 - Long-range Unmanned Aerial Systems
 - Automated Identification System (AIS)
 - Advance Notice of Arrival (ANOVA) system
- Emerging Technologies
 - Tagging and tracking technologies
 - Automated data mining and data fusion
 - Long range surveillance (MMA-UAS)





Technologies That Support MDA in the Exclusive Economic Zone

Technologies That Support MDA in the EEZ

- Existing Capabilities
 - Satellite radars
 - Over the horizon radars
 - Acoustic means to generate contacts
 - Vessel reporting systems
- Emerging Technologies
 - ADS
 - DADS
 - High-speed manned and unmanned surface and air systems
 - Data correlation and data fusion





Technologies That Support MDA in the Territorial Sea and Contiguous Zone

- Immediate threat from unidentified vessels
- Existing Capabilities
 - Patrol boats / vessels / aircraft
 - AIS shore stations
 - Vessel reporting systems
- Emerging technologies
 - ADS
 - DADS
 - Larger naval and Coast Guard vessels (Deepwater)
 - Enhanced data correlation and data fusion





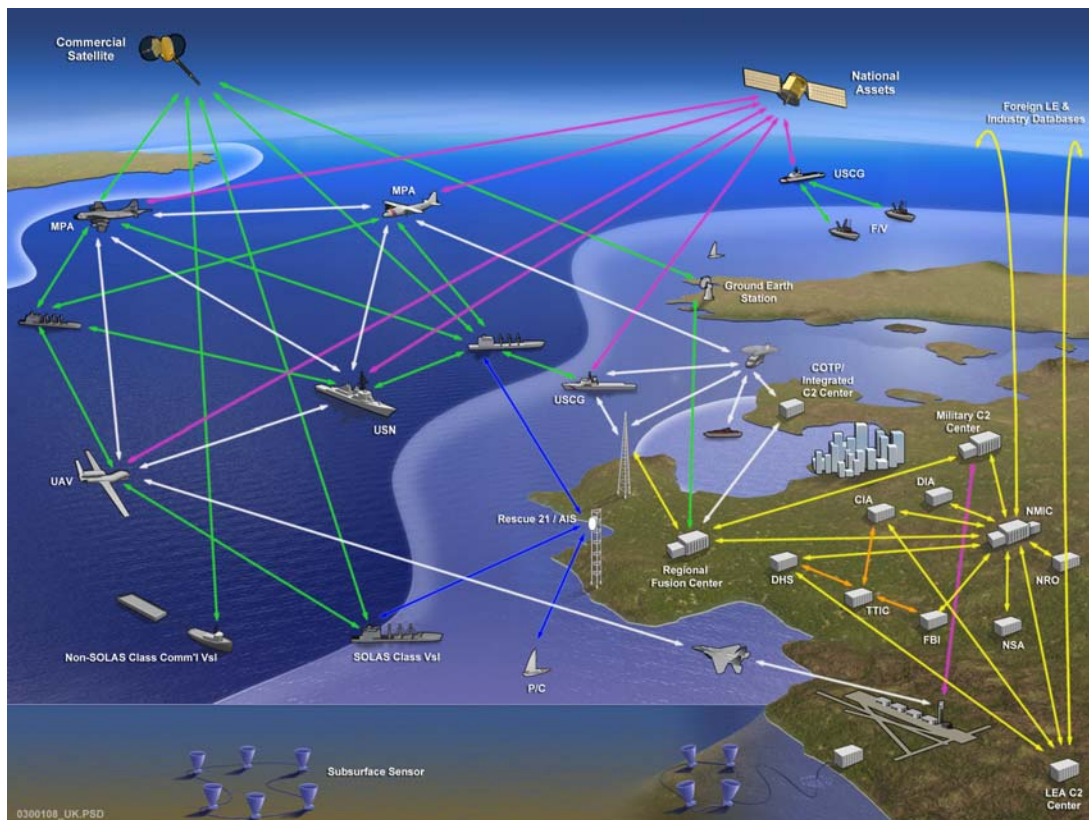
Technologies That Support MDA in Ports, Bays, and Inland Waterways

Technologies That Support MDA in Ports, Bays and Inland Waterways

- Most “congested” area
 - Contact-identification and sorting more difficult
- Existing Capabilities:
 - Patrol aircraft
 - Airplanes and helicopters
- Emerging Technologies
 - High-speed data correlation and data fusion
 - Networked surface and air assets (GIG/FORCEnet)
 - Knowledge management



From Seabed to Space ...



- **Sensors / Collection**
 - Systems w/ integrated comms/ networking and onboard processing to support automated fusion and cueing and formatting to support Service Oriented Architecture
- **Correlation**
 - Algorithms to improve correlation of complex signals
 - Automation of correlation functions
- **Fusion**
 - All-source fusion to support pattern recognition and anomaly detection
- **Supporting Decision-making and deriving meaning, not just volumes of data**

... across the zones



Technical Capabilities: Dynamic Decision Support



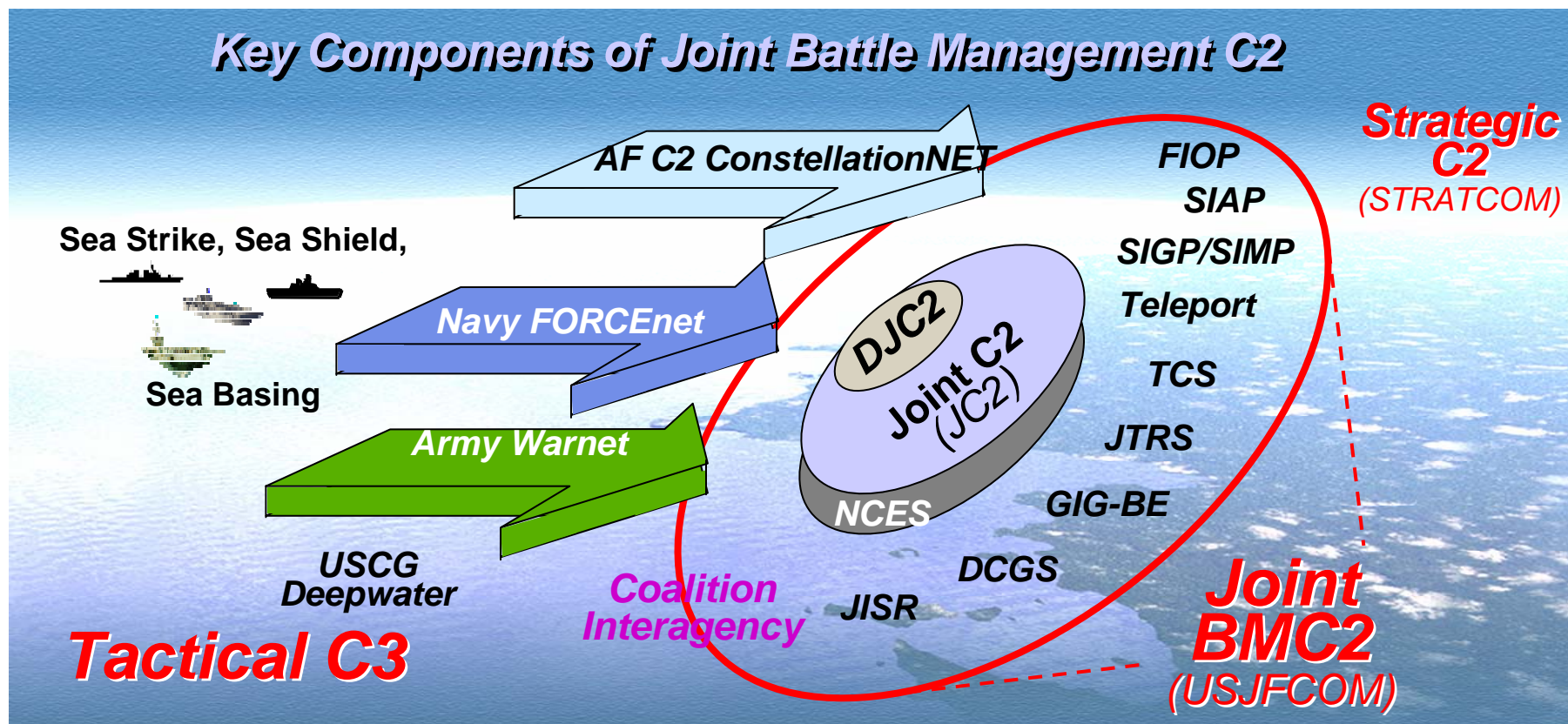
Technical Capabilities Dynamic Decision Support



- Backbone is the Global Information Grid
- Maritime Context – U.S. Navy FORCEnet
- Initial Design – “Composeable FORCEnet”
- “Coalition-friendly” design and operation

Global Information Grid (GIG) Naval Component - FORCEnet

FORCEnet Is an *Inherently Joint/Coalition Concept*, Both Relying on and Providing Essential Capabilities to the Joint/Coalition Community and Other Services and Agencies



What Is FORCEnet?

Network Centric Warfare Is the Theory

Net-centric Operations Is the Concept

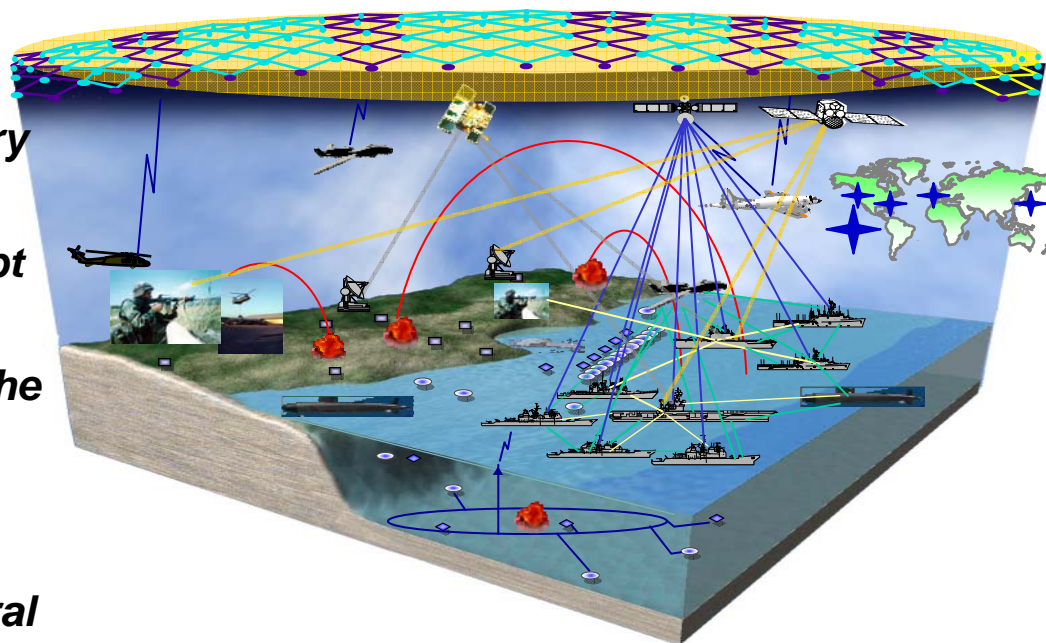
FORCEnet Is the Process of Making the Theory and Concept a Reality

“FORCEnet is defined as the operational construct and architectural framework for naval warfare in the Information Age, integrating warriors, sensors, command and control, platforms, and weapons in a networked, distributed combat force”

Source - *FORCEnet: A Functional Concept for the 21st Century:*

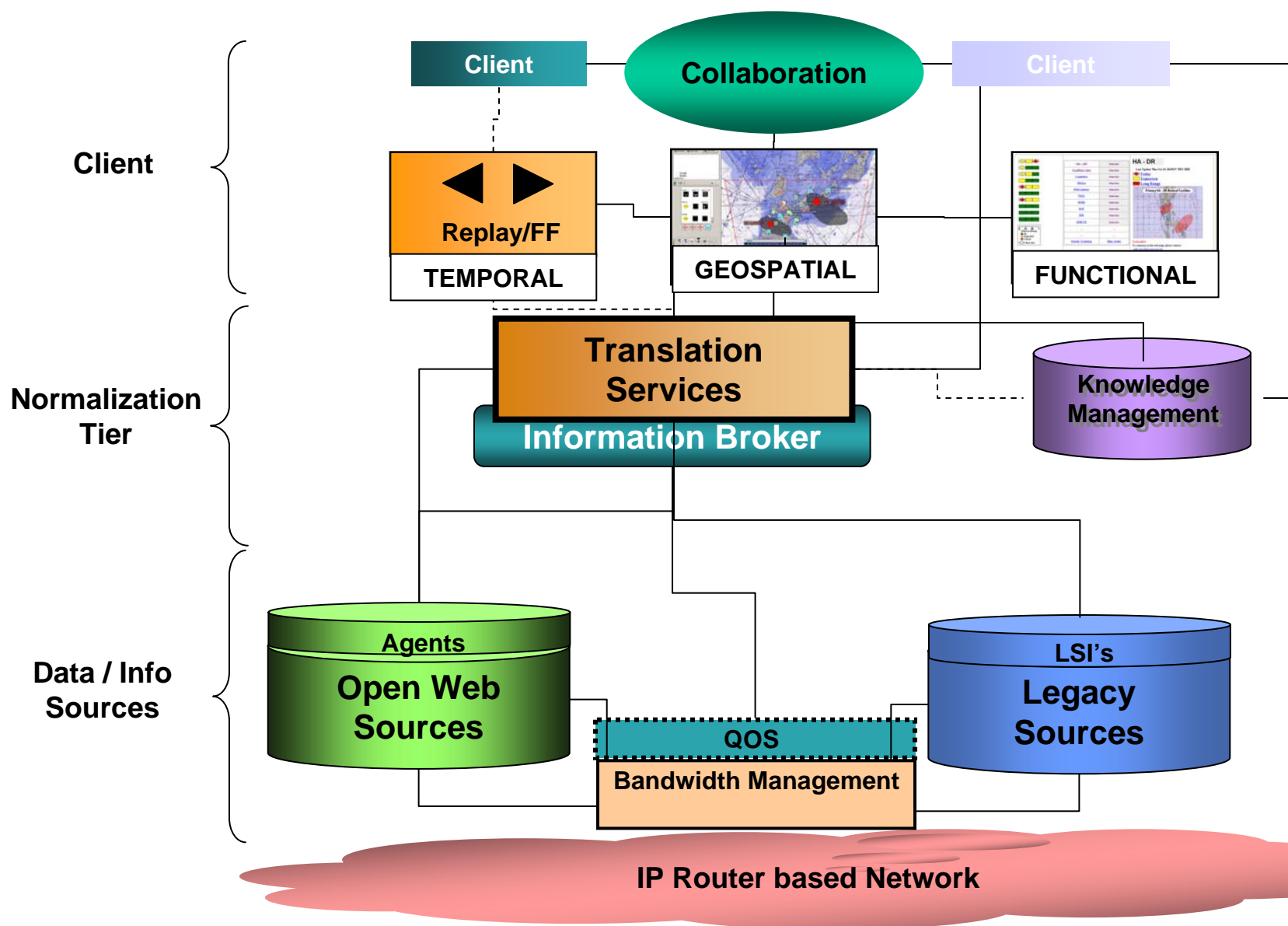
Naval Network Warfare Command

February 2005



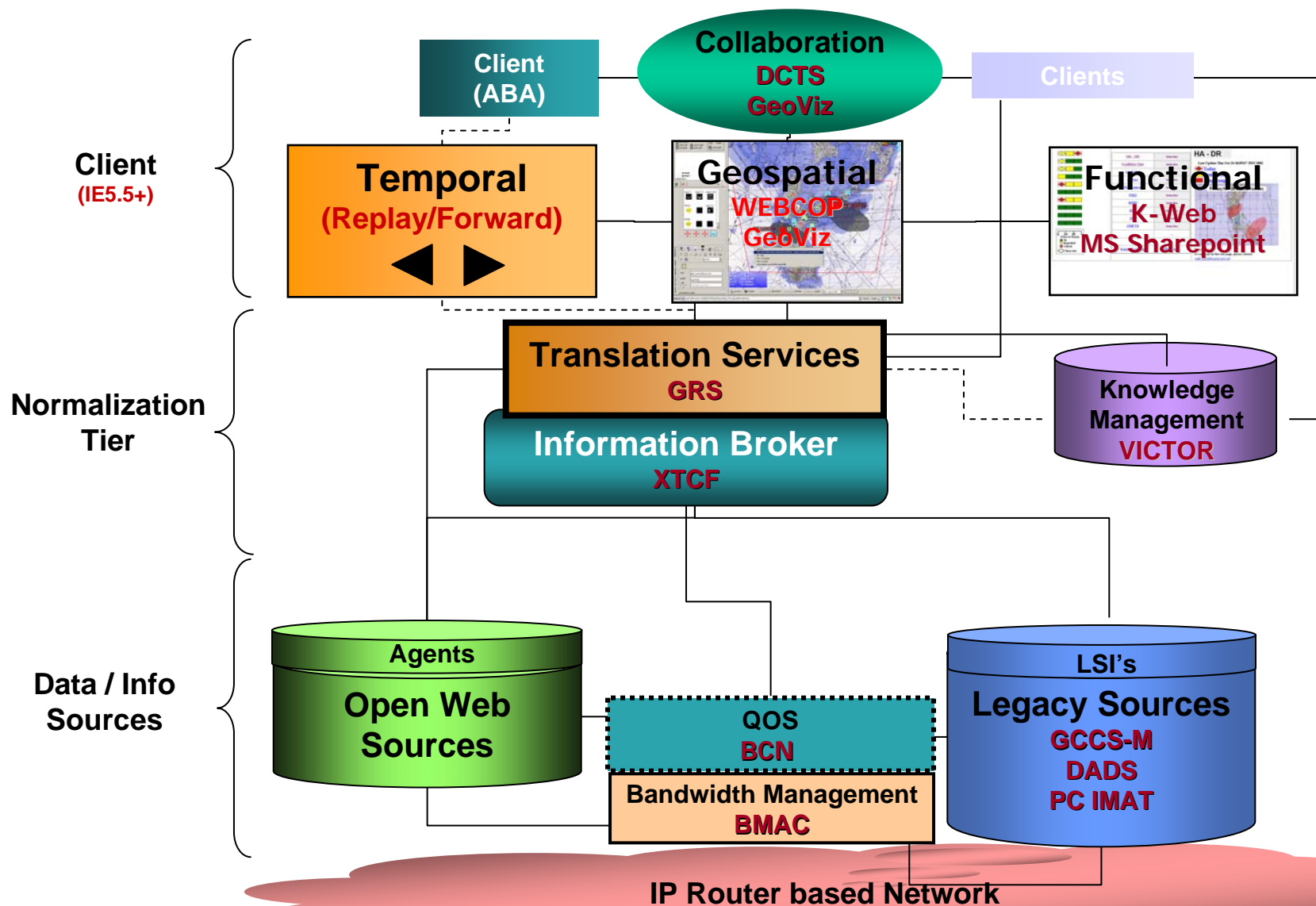
- **FORCEnet Is Not**
 - A Program of Record
 - A Redundant Effort
 - A Box or System
 - Just a Network

Composeable FORCEnet Architecture Maximizes Interoperability



Composeable FORCEnet Architecture

**It's about Composeable Functionality
– Not the Specific Components**



Where Composeable FORCEnet is Currently Deployed

CTF72 (Misawa)

**CTF74/COMSUBG
RU7 (Yokosuka)**

CTG72.2 (Kadena)

USS Blue Ridge

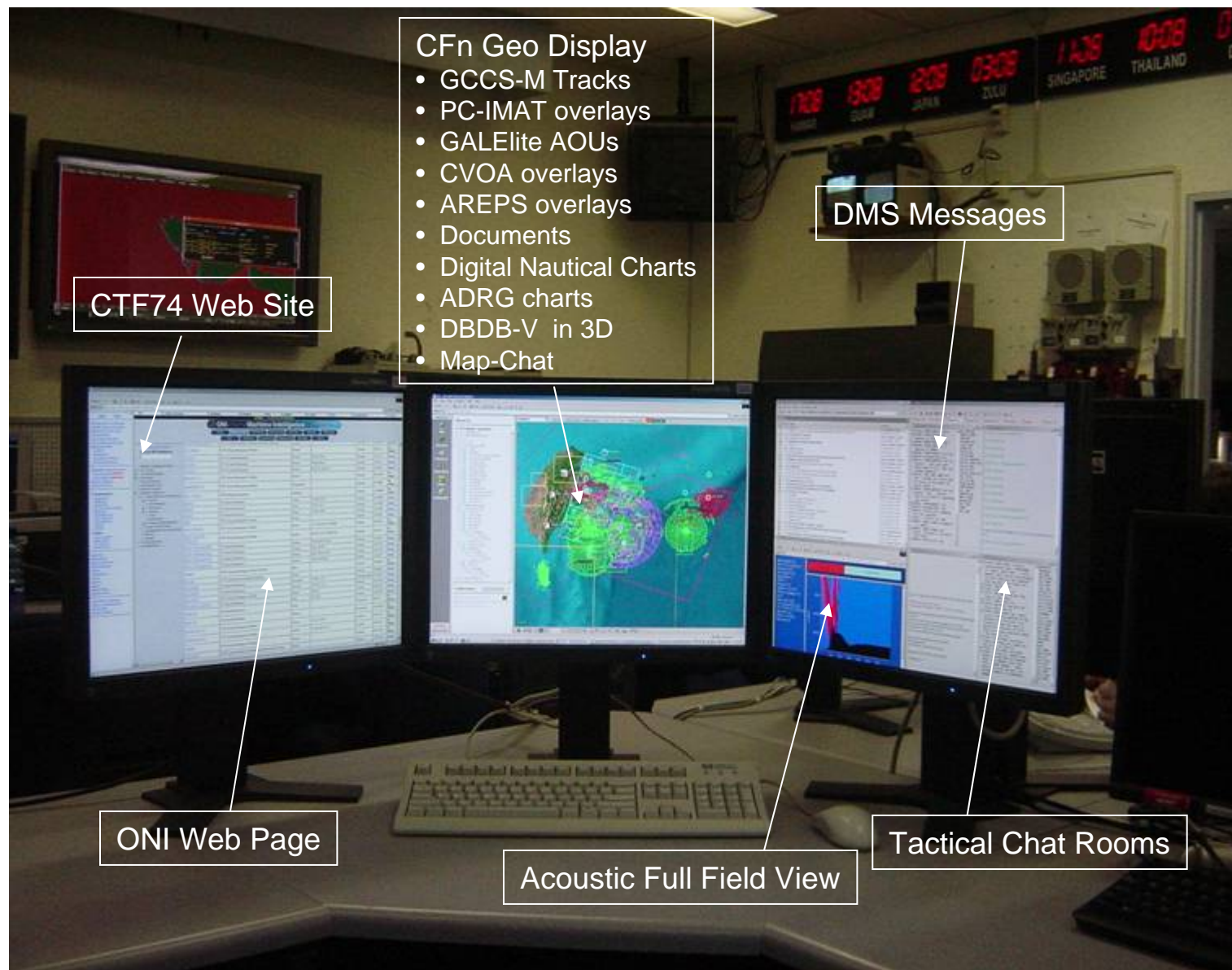
USS Kitty Hawk

USS Ronald Reagan

USS Abraham Lincoln



CTF-74 TASW CFn Battle Watch Captain



CFn Web based C2 provides improved understanding

Summary and Conclusions

- The importance of gaining situational awareness in the maritime domain will increase
- Policy and operational approaches have been fragmented and uncoordinated – *until now*
- Technologies to generate actionable intelligence have not been available – *until now*
- These technologies are now available and emerging supported by a C4ISR infrastructure
- Focusing on functional capabilities first will enable optimal technical solutions – *start now*



BACKUPS



“We will not win the Global War on Terrorism if we cannot tell the bad guys from the good guys. We have to develop the capability to do that. A maritime NORAD is essential.”

Admiral Vern Clark
Chief of Naval Operations
Signal Magazine
December 2004



“The IT revolution represents the most significant global transformation since the Industrial Revolution beginning in the mid-18th Century.”

National Intelligence Council



“Modern warfare strains the capacity to communicate...the challenge is building a system that ensures that we get the right information to the right place at the right time....”

The Wall Street Journal
April 10, 2002

Technical Capabilities: Focused Sensing and Data Acquisition

- **Tool:** to better use and extract data from existing sensors
- **Need:** to address/answer several questions:
 - What data structures are being used?
 - How is data registered?
 - Is data discoverable from other sensors?
 - What is pedigree of information?
- **Goal:** to have autonomous sensors and establish thresholds to alert operator of abnormal activity



“Ensuring the security of the Maritime Domain must be a global effort in which U.S. Government efforts are developed and furthered with the support of other governments.”

NSPD-41/HSPD-13
December 21, 2004



Maritime Domain Awareness

The Key to Maritime Security

RDML J. L. NIMMICH

*Asst. Commandant for Policy and Planning
United States Coast Guard*

28 June 2006

